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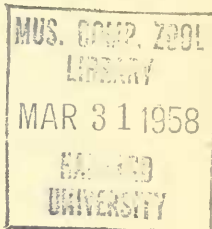
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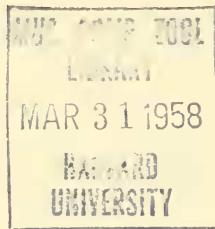
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# Geographic Variation in the Pocket Gopher, *Thomomys bottae*, in Colorado

BY

PHILLIP M. YOUNGMAN

## INTRODUCTION

Two species of pocket gophers of the genus *Thomomys* (Family Geomyidae) occur in Colorado, *Thomomys bottae* (see fig. 1) in the low valleys in the south-central and southwestern parts of the state and *Thomomys talpoides* mainly in the mountains and high valleys.

*Thomomys bottae* occurs primarily in the Piñon-juniper, Ponderosa Pine, and Short Grass zones of Daubenmire (1943) but in some localities is found in the Douglas Fir Zone. *Thomomys talpoides* occupies primarily the Douglas Fir Zone and Engelmann Spruce-Subalpine Spruce Zone but is found also in the Piñon-juniper and Short Grass zones in some localities.

The ranges of the two species do not overlap in the strict sense but interdigitate in a parapatric type of distribution.

Two other pocket gophers, *Geomys bursarius* and *Cratogeomys castanops*, also occur in Colorado—in the Upper Sonoran Life-Zone. *Geomys bursarius* occupies much of the Great Plains, whereas *Cratogeomys castanops* is found only on the plains in the southeastern part of the state.

The objectives of the study, reported on here, were to learn the geographic distribution of *Thomomys bottae* in Colorado, to find means for recognizing the different subspecies, and to describe individual and geographic variation.

I am indebted to Mr. Sydney Anderson and Professor E. Raymond Hall for many helpful suggestions and for their critical reading of the manuscript, to Dr. Richard S. Miller, who made the collection of many of the specimens possible, and to Dr. Richard M. Hansen for numerous suggestions. I wish to express my appreciation also to the following for the loan of specimens in their care: Alfred M. Bailey and A. A. Rogers, Colorado Museum of Natural History, Denver, Colorado; David H. Johnson, United States National Museum, Washington, D. C.; Robert W. Lechleitner, Colorado State University, Fort Collins, Colorado; and Robert Z. Brown, Colorado College, Colorado Springs, Colorado.

## METHODS

Adults of approximately equal age were compared in the study of geographic variation. Three criteria of adulthood are: (a) suture obliterated between supraoccipital and exoccipital, (b) suture at least partly obliterated between basisphenoid and basioccipital, (c) supraorbital crests not widely separated and almost parallel. In males the crests encroach on the lateral borders of the interparietal; in females the crests approach the lateral borders of the interparietal but are more widely separated than in males.

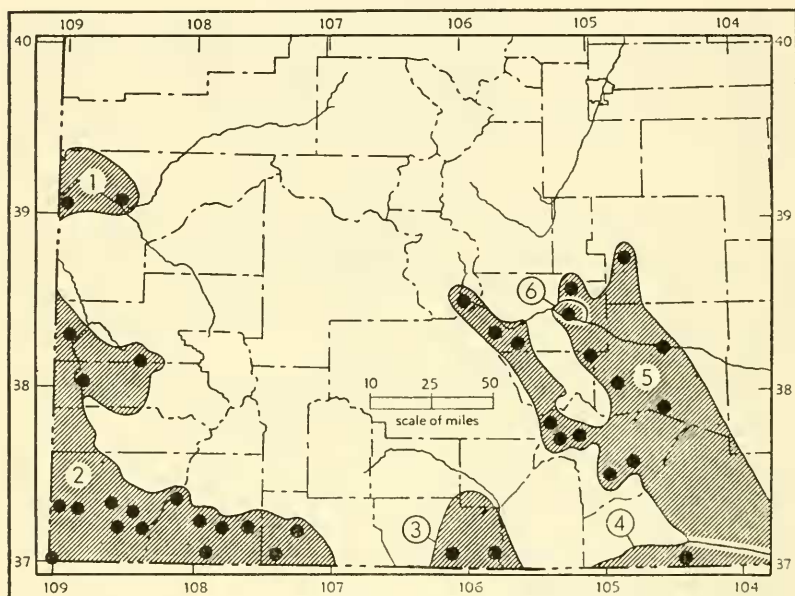


FIG. 1. Geographic distribution of *Thomomys bottae* in southwestern Colorado.

- |                          |                            |
|--------------------------|----------------------------|
| 1. <i>T. b. howelli</i>  | 4. <i>T. b. cultellus</i>  |
| 2. <i>T. b. aureus</i>   | 5. <i>T. b. internatus</i> |
| 3. <i>T. b. pervagus</i> | 6. <i>T. b. rubidus</i>    |

In studying geographic variation, greater emphasis was placed on females than on males. As noted by Grinnell (1931:4), males vary more than females, especially in length of rostrum and associated nasal measurements.

Color terms are those of Munsell (1954). Color measurements were standardized by the use of a single 100 watt General Electric blue daylight bulb in a 12 inch white reflector suspended 24 inches above the specimen. All other light was excluded. The individual hairs of *Thomomys bottae* are either bi-colored or tricolored. The darkness of a specimen often may be attributed to the presence of dark-tipped hairs. The color given in the description is the basic reddish or yellowish color of the hairs. The presence of a grizzled effect or a dark dorsal stripe, or any other pattern resulting from dark hairs, is noted in the remarks.

Specimens examined are listed by counties in the following order:

Mesa	Montezuma	Chaffee	Custer
Montrose	La Plata	Fremont	Huerfano
San Miguel	Archuleta	El Paso	Alamosa
Dolores	Conejos	Pueblo	Las Animas

Localities are listed from north to south within a county. If two localities lie on the same line of latitude, the western precedes the eastern. Localities omitted on the map in order to prevent overlapping of symbols are in *Italics*. Unless otherwise indicated, specimens are in the University of Kansas, Museum of Natural History. The following initials are used to designate specimens in other collections:

CSU—Colorado State University, Fort Collins, Colorado.

CMNH—Colorado Museum of Natural History, Denver, Colorado.

ERW—E. R. Warren Collection, Colorado College, Colorado Springs, Colorado.

USNM—United States National Museum, Washington, D. C.

The following measurements of the skull are listed in the tables:

*Condylbasal length*.—The shortest distance between the anteriormost projections of the premaxillaries and a line touching the posterior surfaces of the occipital condyles.

*Length of nasals*.—The distance from the most anterior projection of the nasal bones to the most posterior projection of a nasal bone.

*Zygomatic breadth*.—The greatest distance across the zygomatic arches, at right angles to the long axis of the skull.

*Squamosal breadth*.—The greatest distance between the mastoidal processes of the squamosal.

*Length of rostrum*.—The shortest distance from the shallow notch that lies lateral to the hamulus of the lacrymal bone, to the tip of the nasal on the same side of the skull.

*Breadth of rostrum*.—The greatest width of the rostrum, anterior to the maxillae, transverse to the long axis of the skull.

*Alveolar length of upper maxillary tooth-row*.—Distance between the anterior margin of the alveolus of the first cheek-tooth and the posterior margin of the alveolus of the last upper cheek-tooth, on one side of the skull.

*Least interorbital breadth*.—The least distance across the frontal bones at the interorbital constriction as seen in dorsal view.

## PHYSIOGRAPHY

*Thomomys bottae* occurs in the Colorado Plateau Province (terminology of Fenneman, 1931), the Southern Rocky Mountain Province and a small part of the Great Plains Province.

The Colorado Plateau Province, in the southwestern part of the state, is mostly above 5000 feet and is characterized by the great number of canyons cut by rivers and streams in the nearly horizontal strata. Prominent features of the landscape are *cuestas*, such as Mesa Verde, and *laccoliths*, such as Ute Peak.

The Southern Rocky Mountain Province consists mainly of high granitic mountains running north and south, many of which extend

to more than 14,000 feet above sea level. Included in this region are several large basins, such as North Park and South Park and the San Luis Valley. The San Juan Mountains, which separate the Colorado Plateau Province from the San Luis Valley, and the Sangre De Cristo and Wet mountains, which intervene between the San Luis Valley and the Great Plains, importantly influence the distribution of *Thomomys bottae*.

The Great Plains Province is a broad highland that slopes gradually eastward from the Rocky Mountains. Of importance to the present study are two subdivisions of the Great Plains, the Colorado Piedmont and the Raton Section.

The Colorado Piedmont is a much dissected fluvial plain, roughly extending from the vicinity of the Arkansas River to the northern boundary of the state. In general the topography of the Colorado Piedmont is broadly rolling with greater relief than the high plains to the east; however, buttes and steep bluffs occur locally.

The Raton Section imperceptibly blends into the southern boundary of the Colorado Piedmont and extends south into New Mexico and Texas. A trenched peniplane of greater relief and altitude than the Colorado Piedmont, it is characterized by high mesas, extensive dissected lava-capped plateaus, deep canyons, and mountains of volcanic origin.

#### GEOGRAPHIC VARIATION

Six subspecies of *Thomomys bottae* occur in Colorado. *T. b. aureus* and *T. b. howelli* occupy the Colorado Plateau Province (see fig. 1) and are characterized by a yellowish color; nasals posteriorly truncate or rounded; posterior extensions of premaxillae long; basioccipital wide; and interpterygoid space U-shaped with a median spicule.

*T. b. internatus*, *T. b. cultellus*, and a new subspecies from the vicinity of Cañon City described on page 376, inhabit the Sangre De Cristo and Wet mountains in the Southern Rocky Mountain Province and adjacent parts of the Colorado Piedmont and Raton Section of the Great Plains Province (see fig. 1). This group of closely related subspecies is characterized by reddish color; posterior margins of nasals forming a V; posterior extensions of premaxillae short; basioccipital narrow; and interpterygoid space V-shaped, lacking a median spicule.

*T. b. pervagus* occupies part of the San Luis Valley to the west of the Rio Grande (see fig. 1). In Colorado *T. b. pervagus* is iso-



lated from *T. b. internatus* and *T. b. cultellus* by the Sangre De Cristo and Culebra ranges and is separated from *T. b. aureus* by the San Juan Mountains. *T. b. pervagus* occupies an area geographically intermediate between *T. b. aureus* to the west and *T. b. internatus* and *T. b. cultellus* to the east and has some characters in common with these subspecies. *T. b. pervagus* resembles *T. b. aureus* in having long posterior extensions of the premaxillae and in sometimes having rounded posterior margins of the nasals. *T. b. pervagus* resembles *T. b. internatus* and *T. b. cultellus* in color, the presence of a V-shaped interpterygoid space, and a narrow basioccipital. Kelson (1951:69) has pointed out that in New Mexico the separation of the ranges of *T. b. pervagus* and *T. b. cultellus* is probably complete, but probably incomplete between *T. b. pervagus* and *T. b. aureus*. Nevertheless, the similarities between *T. b. pervagus* and *T. b. cultellus* and *T. b. internatus* suggest that *T. b. pervagus* was originally derived from the more eastern stock.

*T. b. aureus* is a variable subspecies which, according to Durrant (1952:211), intergrades with *T. b. howelli* in Utah. Specimens of *T. b. aureus* showing the greatest amount of geographic variation cranially are from the ecotone between the Piñon-juniper and Douglas Fir zones at the edge of the range of the subspecies.

*T. b. howelli* is a markedly distinct subspecies that shows certain similarities to *T. b. aureus*, but the degree of cranial difference from *T. b. aureus* suggests an isolation of long duration, or a rapid evolution from the parent stock.

*T. b. internatus* and *T. b. cultellus* probably intergrade east of the Sangre De Cristo Range in the vicinity of the Colorado-New Mexico boundary. The amount of intergradation is obscured by the great amount of geographic variation occurring in *T. bottae* at the edge of the plains and by the lack of specimens from this area.

*T. b. internatus* is a widespread subspecies showing its greatest variation at the edge of the plains. This area is an ecotone between the coniferous forest and the grassland and is by nature an area of change owing to the alternation of wet and dry periods such as the pluvial, interpluvial, and postpluvial periods. This seems to support Durrant's observation (1952:496) that "the greatest range of morphological variation is in animals from the least stable environments."

Specimens from a small area north of the Arkansas River in the vicinity of Cañon City (see fig. 1) differ sufficiently from *T. b. internatus* to be given nominal recognition. High mountains and the Arkansas River isolate the new subspecies found at Cañon City from

populations of *T. b. internatus* to the west and south; however there are no apparent geographic barriers between the newly named subspecies and populations of *T. b. internatus* twelve miles to the north or from the vicinity of Pueblo to the east. This new subspecies is the most extreme of the variants occurring in the unstable environment at the edge of the plains.

### *Thomomys bottae aureus* Allen

*Thomomys aureus* Allen, Bull. Amer. Mus. Nat. Hist., 5:49, April, 1893; Warren, Colorado College Publ., 19:252, January, 1906; Warren, Colorado College Publ., 33:77, January, 1908; Warren, Mammals of Colorado, p. 79, 1910; Cary, N. Amer. Fauna, 33:136, August 17, 1911.

*Thomomys bottae aureus*, Goldman, Proc. Biol. Soc. Washington, 48:156, October 31, 1935; Warren, Mammals of Colorado, p. 158, 1942.

*Thomomys apache* Bailey, Proc. Biol. Soc. Washington, 23:79, May 4, 1910. Holotype from Lake La Jara, 7500 feet, Rio Arriba County, New Mexico.

*Thomomys perpallidus aureus*, Bailey, N. Amer. Fauna, 39:74, November 15, 1915.

*Thomomys perpallidus apache*, Bailey, N. Amer. Fauna, 39:75, November 15, 1915.

*Thomomys bottae apache*, Goldman, Proc. Biol. Soc. Washington, 48:157, October 31, 1935; Warren, Mammals of Colorado, p. 160, 1942.

*Thomomys bottae optabilis* Goldman, Jour. Washington Acad. Sci., 26:116, March 15, 1936. Holotype from Coventry, 6500 feet, Montrose County, Colorado; Warren, Mammals of Colorado, p. 159, 1942, part.

*Holotype*.—Adult female, skin and skull number 4743, American Museum of Natural History, obtained at Bluff City, San Juan County, Utah, May 12, 1892, by Charles P. Rowley.

*Distribution*.—Colorado Plateau Province of southwestern Colorado (see fig. 1), northwestern New Mexico, southeastern Utah, and northeastern Arizona.

*Distinctive characters*.—Size large (see measurements); usually pale in western part of range, dark in eastern part; posterior extensions of premaxillae long, wide, and deeply serrated; posterior margins of nasals truncate or slightly rounded (see fig. 2); interpterygoid space U-shaped, with median spicule; basioccipital wide; bullae well inflated, rounded ventrally.

*Comparisons*.—For comparisons with *T. b. howelli* and *T. b. pervagus*, see accounts of those subspecies.

*Remarks*.—*T. b. aureus* is a variable subspecies, which differs considerably from *T. b. internatus*, *T. b. cultellus*, and *T. b. rubidus* and includes several microgeographic races distinguishable to a taxonomist specializing in the group. These slightly varying populations are here not considered sufficiently distinct for nominal recognition.

Characters such as color of the pelage and conformation of the bullae and zygomatic arches vary with the locality, and to some extent vary among specimens from a single locality.

The name *Thomomys bottae optabilis*, given to specimens from



Coventry by Goldman (1936:116), is here placed in synonymy under *T. b. aureus* Allen. The characters originally used to describe *T. b. optabilis* are of the type that vary between populations only a few miles apart, or often vary within a population. The skulls of specimens from Coventry are not lighter in structure than those of *T. b. aureus*. The premaxillae are not narrower, nor is the frontal region narrower or more constricted than in *T. b. aureus*.

The name *Thomomys bottae apache*, given to specimens from Lake La Jara, New Mexico, by Bailey (1910:79), and later applied to specimens from Colorado by Bailey (1915:75), is here also placed in synonymy under *T. b. aureus*. Specimens from Lake La Jara, New Mexico, and nearby localities in Colorado may be separated from topotypes of *T. b. aureus* on the basis of color only. The topotypes of *T. b. aureus* are mostly pale; some, however, are dark. The number of pale specimens in any given series decreases gradually in a clinal pattern from west to east. Since there is no noticeable step in the cline and since all specimens show close cranial similarity, it is felt that nominal recognition of the darker specimens does not present a realistic picture of the relationships of the relatively unisolated populations in the Colorado Plateau Province.

Since *Thomomys bottae* in the Colorado Plateau Province is especially plastic, varying from locality to locality, emphasis is here placed on similarities that unite specimens from different localities. The individual and microgeographic variations are outlined below.

Specimens from Bedrock have zygomatic arches that are heavy anteriorly. Specimens from Coventry are dorsally almost uniformly Strong Brown (7.5YR 5/6) and lack a strong dorsal stripe. The venters are Reddish Yellow (7.5YR 8/6). Specimens from 15 miles west of Cortez are the palest specimens of *T. b. aureus* from Colorado, and closely resemble topotypes. The basic color varies from Reddish Yellow (7.5YR 7/6 and 6/6) to Strong Brown (7.5YR 5/6). Specimens are marked with a narrow dark dorsal stripe. The venters are white. Specimens from Ute Peak and Cortez have Reddish Yellow (7.5YR 6/6) flanks and are slightly darker dorsally. Many specimens from Mesa Verde are indistinguishable from specimens from Coventry and from Cortez. Others have dark diffuse dorsal stripes. The venters are Pink (7.5YR 7/4) or Pinkish White (7.5YR 8/2). Some specimens from the Mancos River have wide dorsal stripes. Specimens from three miles west of Durango have especially wide-spreading zygomatic arches posteriorly and have wide black dorsal stripes. The venters are Pink (7.5YR 7/4). One specimen from Florida is dark and grizzled and has a dark dorsal

stripe. Another specimen is pale and has only a small dorsal stripe. Specimens from 12 miles west of Pagosa Springs have thin rostra and diffuse dorsal stripes. Specimens from Bondad have a V-shaped interpterygoid space and in it a small median spicule. One specimen is uniformly grizzled and lacks a dorsal stripe, giving an overall effect of Dark Yellowish Brown (10YR 3/3). Another specimen has Strong Brown (7.5YR 5/6) flanks and is only slightly darker dorsally.

*Specimens examined.*—Total 114. *Colorado*: Montrose Co.: West Paradox Valley, 5 (CMNH); Bedrock, 5150 ft., 5 (ERW); Coventry, 6800 ft., 14 (12 ERW, 2 USNM). San Miguel Co.: 19 mi. N Dove Creek, 6100 ft., 1. Montezuma Co.: *Ashbaugh's Ranch* (T.36N, R.18W) 5350 ft., 5 (4 ERW, 1 USNM); 15 mi. W Cortez (Sec. 2, T.35N, R.19W), 5400 ft., 8; Major Ranch, Cortez, 7 (CSU); 3 mi. SSW Cortez, 6400 ft., 1; Ute Peak, 2 (CMNH); Four Corners, 1 (CMNH). Mesa Verde National Park: Upper Well, Prater Canyon, 7575 ft., 1;  $\frac{3}{4}$  mi. S,  $1\frac{3}{4}$  mi. W Park Point, 8000 ft., 3;  $\frac{1}{2}$  mi. N Middle Well, 7500 ft., 1; Sec. 27, Head of E Fork, Navaho Canyon, 7900 ft., 2;  $1\frac{1}{4}$  mi. S,  $1\frac{1}{2}$  mi. W Park Point, 8000 ft., 1; Middle Well, Prater Canyon, 7500 ft., 9; 3 mi. N Rock Springs, 8200 ft., 4;  $1\frac{1}{2}$  mi. S, 2 mi. W Park Point, 8075 ft., 1;  $2\frac{1}{2}$  mi. N,  $\frac{1}{2}$  mi. W Rock Springs, 8100 ft., 3; 2 mi. N,  $\frac{1}{4}$  mi. W Rock Springs, 7900 ft., 2;  $\frac{1}{2}$  mi. N Far View Ruins, 7825 ft., 1; Far View Ruins, 7700 ft., 1; 1 mi. NNW Rock Springs, 7500 ft., 1; Rock Springs, 7400 ft., 1; Mancos River, 6200 ft., 9; Mesa Verde, 1 (USNM). La Plata Co.: 1 mi. N La Plata, 1; 3 mi. W Durango, 5; Florida, 6800 ft., 5; Bayfield, 1 (USNM); Bondad, 6 (CMNH); Archuleta Co.: 12 mi. W Pagosa Springs, 6700 ft., 2; Arboles, 1 (USNM). *New Mexico*: Rio Arriba Co.: La Jara Lake, 7500 ft., 2 (USNM).

### *Thomomys bottae howelli* Goldman

*Thomomys bottae howelli* Goldman, Jour. Washington Acad. Sci., 26:116, March 15, 1936; Warren, Mammals of Colorado, p. 161, 1942.

*Thomomys aureus*, Cary, N. Amer. Fauna, 33:136, August 17, 1911, part.

*Thomomys perpallidus aureus*, Bailey, N. Amer. Fauna, 39:74, November 15, 1915, part.

*Holotype.*—Adult female, skin and skull, number 75684, United States National Museum, obtained by Arthur H. Howell at Grand Junction, 4600 feet, Mesa County, Colorado, November 7, 1895.

*Distribution.*—Colorado Plateau Province of west-central Colorado and east-central Utah, in the Colorado River Valley east of the Green River (see fig. 1).

*Distinctive characters.*—Pale (Pinkish White 7.5YR 8/2); cranium flattened; nasals short and wide; posterior tongues of premaxillae long, thin, and attenuate (see fig. 3).

*Comparisons.*—Compared with *T. b. aureus*, *T. b. howelli* differs as follows: paler; nasals shorter and wider; cranium more flattened; posterior extensions of premaxillae longer, thinner, and more acuminate.

*Remarks.*—*T. b. howelli* most closely resembles *T. b. aureus*; however, since only one adult specimen of *T. b. howelli* is known, it is impossible to appraise adequately its characters. Durrant (1952: 211) records intergradation between *T. b. howelli* and *T. b. osgoodi*, and between *T. b. howelli* and *T. b. aureus* in Utah.

An attempt to collect specimens of *T. b. howelli*, in March, 1957, by Richard S. Miller and the writer was unsuccessful.

*Specimens examined*.—Total 2. Mesa Co.: Grand Junction, 4600 ft., 1 (USNM); Sieber Ranch, Little Doloris River, 1 (ERW).

### *Thomomys bottae pervagus* Merriam

*Thomomys aureus pervagus* Merriam, Proc. Biol. Soc. Washington, 14:110, July 19, 1901; Cary, Proc. Biol. Soc. Washington, 20:26, March 27, 1907; Warren, Colorado College Publ., 33:77, January, 1908; Warren, Mammals of Colorado, p. 79, 1910, part; Cary, N. Amer. Fauna, 33:137, August 17, 1911, part.

*Thomomys bottae pervagus*, Goldman, Proc. Biol. Soc. Washington, 48:157, October 31, 1935.

*Thomomys fulvus pervagus*, Bailey, N. Amer. Fauna, 39:82, November 15, 1915.

*Holotype*.—Adult male, skin and skull, number 58293, United States National Museum, Espanola, Rio Arriba County, New Mexico, obtained by J. Alden Loring, January 4, 1894.

*Distribution*.—Upper Rio Grande and San Luis valleys of the Southern Rocky Mountains, in northern New Mexico and southern Colorado (see fig. 1).

*Distinctive characters*.—Yellowish Red (5YR 4/6); size large (see measurements); posterior tongues of premaxillae long, thin, and acuminate; nasals long, thin, posterior margins usually forming a wide V (see fig. 4); bullae rounded ventrally; interpterygoid space V-shaped, lacking median spicule.

*Comparisons*.—From *T. b. aureus*, *T. b. pervagus* differs as follows: reddish, never yellowish or blackish; posterior tongues of premaxillae thin and not deeply serrated; posterior margins of nasals forming a shallow V; interpterygoid space V-shaped, lacking a median spicule; basioccipital narrow. For comparisons with *T. b. internatus*, *T. b. cultellus*, and *T. b. rubidus*, see accounts of those subspecies.

*Remarks*.—*T. b. pervagus* is a well-defined subspecies. There is little variation between the topotypes and specimens from Colorado.

*Specimens examined*.—Total 20. Colorado: Conejos Co.: Antonito, 5 (USNM); 7 mi. E Antonito, 2 (USNM); 12 mi. E Antonito, 1 (USNM); Conejos River, 6 mi. W Antonito, 8300 ft., 2 (USNM). New Mexico: Rio Arriba Co.: Espanola, 10 (USNM).

### *Thomomys bottae internatus* Goldman

*Thomomys bottae internatus* Goldman, Jour. Washington Acad. Sci., 26:115, March 15, 1936; Warren, Mammals of Colorado, p. 160, 1942; Kelson, Univ. Kansas Publ., Mus. Nat. Hist., 5:63, October 1, 1951.

*Thomomys aureus pervagus*, Warren, Mammals of Colorado, p. 80, 1910, part; Cary, N. Amer. Fauna, 33:137, August 17, 1911, part.

*Thomomys fulvus pervagus*, Bailey, N. Amer. Fauna, 39:82, November 15, 1915, part.

*Holotype*.—Adult male, skin and skull, number 150997, United States National Museum, obtained at Salida, 7000 feet, Chaffee County, Colorado, by Merritt Cary, November 10, 1907.

*Distribution.*—Southern Rocky Mountain Province; southwestern part of the Colorado Piedmont, and Raton Section of the Great Plains, to the east of the Sangre De Cristo Range (see fig. 1).

*Distinctive characters.*—Yellowish Red (5YR 5/6.5); size medium (see measurements); posterior tongues of premaxillae short; posterior margins of nasals forming a V (see fig. 6); bullae pointed ventrally; interpterygoid space V-shaped, lacking a median spicule; basioccipital narrow.

*Comparisons.*—From *T. b. pervagus*, topotypes of *T. b. internatus* differ as follows: uniformly paler, not so reddish; smaller; skull smaller; posterior tongues of premaxillae shorter; bullae smaller, less inflated, and more pointed ventrally; zygomata less angular.

For comparisons with *T. b. cultellus* and *T. b. rubidus*, see accounts of those subspecies.

*Remarks.*—The dividing line between *T. b. internatus* and *T. b. cultellus* is drawn arbitrarily since only one specimen has been collected between La Veta Pass and the border of New Mexico.

When Goldman (1936:115) named *T. b. internatus* he included specimens from Union and Colfax counties, New Mexico, and specimens from Gardner, Colorado (not Garfield as stated by Kelson, 1951:66). The specimens from New Mexico and a specimen from Fishers Peak, Colorado, were subsequently assigned to *T. b. cultellus* by Kelson (*loc. cit.*).

The specimen from Fishers Peak shows some characters that might be interpreted as intermediate between *internatus* and *cultellus*, but shows also some unique characters that can be understood only by further collecting in the regions north and northeast of the type locality of *T. b. cultellus*.

Variation is slight in the large series of topotypes of *T. b. internatus*. Specimens from other localities in the western part of the range differ little from the topotypes. Specimens from one mile west of Coaldale have slightly more inflated bullae that are more flattened ventrally. Specimens from five miles south of Cotopaxi also have the bullae more flattened ventrally.

Specimens from localities bordering the plains differ from the topotypes and near topotypes, and in general show greater variation from locality to locality. Specimens from 12 miles north of Cañon City are dark, resembling *T. b. rubidus*, but cranially agree with specimens from near Colorado Springs in being indistinguishable from specimens from Salida. Specimens from St. Charles Mesa and Bear Creek near Walsenburg differ from the topotypes in having wider rostra. The specimens from St. Charles Mesa have more inflated bullae.

*Specimens examined*.—Total 93. Chaffee Co.: 2 mi. NNW Salida, 7100 ft., 3; *Salida*, 28 (20 ERW, 8 USNM). Fremont Co.: 12 mi. N Cañon City, 5; 1 mi. W Coaldale, 8; *Cotopaxi*, 1 (CSU); 5 mi. S *Cotopaxi*, 12. El Paso Co.: 1½ mi. S Colorado Springs, 2; 9 mi. SSW *Colorado Springs*, 2; 17 mi. S *Colorado Springs*, 1. Custer Co.: 2½ mi. S Wetmore, 3; Santa Fe Drive and 20th Lane, Blende, 1; St. Charles Mesa, 5600 ft., 2 (CSU); Fork of Huerfano and Cucharas rivers, 2 (CMNH). Huerfano Co.: 11 mi. WNW Gardner, 7000 ft., 3; Gardner, 7000 ft., 2 (USNM); 1½ mi. S Redwing, 3; Bear Creek, near Walsenburg, 2 (CSU); 1 mi. E La Veta, 8; 5 mi. SE La Veta, 2.

### *Thomomys bottae cultellus* Kelson

*Thomomys bottae cultellus* Kelson, Univ. Kansas Publ., Mus. Nat. Hist., 5:64, October 1, 1951.

*Thomomys fulvus*, Cary, Proc. Biol. Soc. Washington, 20:26, March 27, 1907; Warren, Colorado College Publ., 33:76, January, 1908; Warren, Mammals of Colorado, p. 80, 1910.

*Thomomys fulvus fulvus*, Bailey, N. Amer. Fauna, 39:80, November 15, 1915.

*Holotype*.—Adult male, skin and skull, number 70919, United States National Museum, Halls Peak, Mora County, New Mexico; January 13, 1895, obtained by C. Barber.

*Distribution*.—Raton Section of the Great Plains in northern New Mexico and extreme southern Colorado (see fig. 1).

*Distinctive characters*.—Dark (topotypes); size medium (see measurements); posterior tongues of premaxillae short; posterior margins of nasals forming a V (see fig. 5).

*Comparisons*.—From *T. b. percagus*, topotypes of *T. b. cultellus* differ as follows: darker, not so reddish; smaller; skull smaller; zygomatic arches relatively longer; bullae proportionately smaller and less inflated; basioccipital proportionately wider; posterior tongues of premaxillae shorter.

Topotypes of *T. b. cultellus* most closely resemble those of *T. b. internatus* but differ as follows: darker; zygomatic arches more widely spreading, not so nearly parallel; nasals not so wide; bullae slightly more inflated.

For a comparison with *T. b. rubidus* see the account of that subspecies.

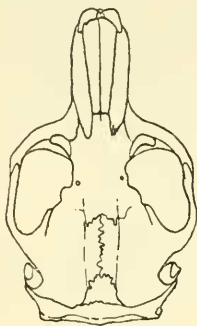
*Remarks*.—Kelson (1951:64) named *T. b. cultellus* on the basis of six dark specimens (Dark Reddish Brown 5YR 3/4 and 2/2). Nowhere else within the range of this subspecies, as defined by Kelson, do any specimens resemble the topotypes in color.

After comparing topotypes of *T. b. cultellus* with topotypes of *T. b. internatus* of approximately equal age, I disagree with Kelson (*loc. cit.*) on some of the characters which he used to separate *cultellus* from *internatus*. My findings indicate that *T. b. cultellus* is not smaller, that its skull is not smaller and not less angular, and that the tympanic bullae are not less pointed ventrally. Further collecting is needed better to limit and diagnose this subspecies.

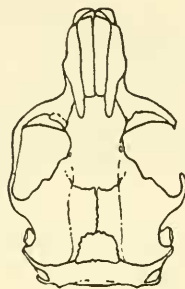
*Specimens examined*.—Total 13. *Colorado*: Las Animas Co.: Fishers Peak, about 8000 ft., 1 (USNM). *New Mexico*: Union Co.: Near Folsom, 4



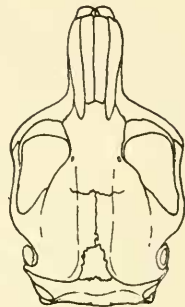
(CMNH); Colfax Co.: Philmont Ranch, Cimarroncito, 8100 ft., 2. Mora Co.: Halls Peak, 6 (USNM).



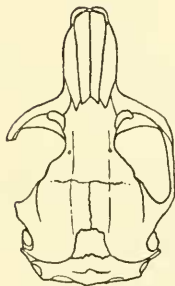
2



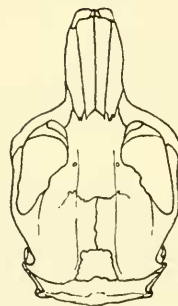
3



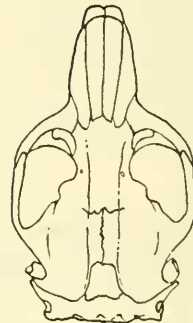
4



5



6



7

FIGS. 2-7. Dorsal views of skulls of *Thomomys bottae*.  $\times 1$ .

FIG. 2. *Thomomys b. aureus*, 3 mi. W Durango, La Plata Co., Colorado. No. 72967, ♀.

FIG. 3. *Thomomys b. howelli*, holotype, Grand Junction, 4600 ft., Mesa Co., Colorado. No. 75684 USNM, ♀.

FIG. 4. *Thomomys b. pervagus*, Espanola, 5000 ft., Rio Arriba Co., New Mexico. No. 133614 USNM, ♀.

FIG. 5. *Thomomys b. cultellus*, Fishers Peak, 8000 ft., Las Animas Co., Colorado. No. 129285 USNM, ♀.

FIG. 6. *Thomomys b. internatus*, Salida, 7050 ft., Chaffee Co., Colorado. No. 2757 ERW, ♀.

FIG. 7. *Thomomys b. rubidus*, holotype,  $2\frac{9}{10}$  mi. E Cañon City, Fremont Co., Colorado. No. 72954, ♀.

### *Thomomys bottae rubidus* new subspecies

*Holotype*.—Adult female, skin and skull, number 72954, Museum of Natural History, University of Kansas, trapped by Richard S. Miller and Phillip M. Youngman, original number 253 (PMY),  $2\frac{9}{10}$  miles east of Cañon City, 5344 feet, Fremont County, Colorado, March 17, 1957.



*Distribution.*—Known only from Garden Park in Cañon City and from the type locality (see fig. 1).

*Distinctive characters.*—Dark (Reddish Brown 5YR 3/3); size large (see measurements); skull large; rostrum wide; zygomatic arches rounded and broadly spreading (see fig. 7); alveolar length of upper maxillary tooth-row small.

*Comparisons.*—From topotypes of *T. b. internatus*, *T. b. rubidus* differs as follows: uniformly darker; skull averages larger in all measurements, except alveolar length of upper maxillary tooth-row, which is smaller; rostrum proportionately wider and tapered anteriorly; zygomatic arches more rounded; bullae more rounded in lateral view.

Specimens of *T. b. rubidus* differ from topotypes of *T. b. pervagus* in darker color; rostrum wider posteriorly; posterior extensions of premaxillae shorter; bullae smaller, proportionately more inflated posteriorly; zygomatic arches more rounded; wider across squamosals; alveolar length of upper maxillary tooth-row greater.

From topotypes of *T. b. cultellus*, *T. b. rubidus* differs as follows: paler; larger in all measurements taken; rostrum proportionately wider; zygomatic arches more rounded, less angular; angle formed by zygomatic arch and rostrum greater; bullae proportionately smaller, not so pointed anteriorly; alveolar length of upper maxillary tooth-row shorter.

*Remarks.*—The range of *T. b. rubidus* is surrounded by the range of *T. b. internatus*; nevertheless, intergradation has not been found. For a discussion of the geographic relation of *T. b. rubidus* to *T. b. internatus* see page 374.

*Specimens examined.*—Total 7. Fremont Co.: Garden Park, Cañon City, 5344 ft., 1;  $2\frac{1}{10}$  mi. E Cañon City, 5344 ft., 6.

## SUMMARY

A study of 249 specimens of *Thomomys bottae* from Colorado reveals six subspecies in the state. *T. b. aureus* and *T. b. howelli* occupy the Colorado Plateau Region in the western and southwestern parts of the state. *T. b. internatus*, *T. b. cultellus*, *T. b. pervagus*, and the newly named *T. b. rubidus* occupy part of the Southern Rocky Mountain Region and a narrow strip of the Great Plains.

The greatest amount of geographic variation, in *Thomomys bottae* in Colorado, occurs in the ecotone between the grassland and coniferous forest at the edge of the Great Plains, and in the ecotone between the Piñon, juniper, and sage of the Colorado Plateau and the Coniferous forest of the southern Rocky mountains.

TABLE 1. MEASUREMENTS, IN MILLIMETERS, OF THOMOMYS BOTTAE  
 Unless otherwise noted, specimens are adults from Colorado

Sex	Catalog number or number of individuals averaged	Total length	Tail	Hind foot	Condylabasal length	Nasal length	Zygomatic breadth	Squamosal breadth	Length of rostrum	Breadth of rostrum	Alveolar length of upper max. tooth-row	Least interorbital breadth
<i>Thomomys bottae howelli</i> , holotype												
♀	75684 <sup>1</sup> sad.....	219	71	29	37.3	11.1	23.7	20.0	14.5	8.5	7.7	6.6
♀	2982 <sup>2</sup> .....	217	59	31	40.4	13.8	24.3	20.6	16.7	8.6	9.2	6.8
♀	3013 <sup>2</sup> .....	210	60	29	38.7	13.0	24.4	20.4	15.7	8.1	8.9	7.0
♂	2997 <sup>2</sup> .....	242	73	33	44.7	15.4	28.4	22.8	15.7	10.1	9.0	7.2
<i>Thomomys bottae aureus</i> , Bedford												
Coventry												
♀	6 av.....	222	61	31	39.0	12.1	25.4	20.3	15.2	7.8	8.2	6.8
	Max.....	229	63	33	40.0	12.8	25.8	20.6	15.6	8.2	8.5	7.0
	Min.....	217	58	30	38.3	11.4	25.0	19.3	14.7	7.5	8.0	6.6
♂	3 av.....	250	70	35	46.5	15.0	29.3	22.7	17.8	9.2	9.5	6.7
	Max.....	270	76	36	48.3	16.0	31.9	23.7	18.0	9.3	9.6	6.9
	Min.....	250	65	35	45.5	14.4	27.6	22.2	17.6	9.2	8.0	6.4

## Ashbaugh's Ranch and 15 mi. W Cortez

♀	7 av.....	225	67	28	39.0	13.7	24.4	20.2	16.1	8.0	8.3	6.3
	Max.....	238	75	31	40.6	14.7	25.0	20.7	16.5	8.5	8.7	6.8
	Min.....	216	55	26	37.8	12.9	23.6	19.7	15.5	7.8	7.9	6.1
♂	4 av.....	247	73	31	44.2	15.9	27.7	22.1	18.6	9.2	8.4	6.4
	Max.....	252	80	34	45.2	16.7	28.8	22.3	19.8	9.6	8.8	6.7
	Min.....	244	67	30	43.7	15.5	27.0	21.7	18.0	8.8	8.0	6.2

## Cortez

♀	5120 <sup>3</sup> .....	224	56	28	38.1	12.3	.....	19.5	15.4	7.5	7.6	6.5
	5121 <sup>3</sup> .....	220	68	31	38.3	11.6	24.2	19.6	15.1	7.6	8.0	6.7
♂	5124 <sup>3</sup> .....	257	81	33	44.4	15.4	29.5	22.2	18.6	8.9	8.6	6.5
	5119 <sup>3</sup> .....	215	62	28	42.0	14.0	27.9	22.1	17.9	8.2	8.6	6.4

## Mesa Verde (combined)

♀	5 av.....	221	63	30	39.0	12.6	24.7	20.2	16.0	8.0	8.2	6.7
	Max.....	235	66	32	40.4	13.7	25.6	21.1	17.3	8.7	8.5	7.1
	Min.....	212	61	28	38.1	12.0	24.1	19.5	15.0	7.7	7.9	6.4
♂	3 av.....	246	74	32	43.7	14.9	27.8	22.3	18.3	8.8	8.9	6.6
	Max.....	252	79	33	45.0	15.2	28.4	23.0	18.5	9.0	9.0	6.8
	Min.....	238	69	31	42.0	14.7	27.5	21.2	18.2	8.7	8.9	6.3

## 1 mi. N La Plata

♂	72966 <sup>4</sup> .....	236	70	31	45.4	15.6	29.4	23.3	20.2	8.8	8.5	6.5
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TABLE I.—Continued

Sex	Catalog number or number of individuals averaged	Total length	Tail	Hind foot	Condylbasal length	Nasal length	Zygomatic breadth	Squamosal breadth	Length of rostrum	Breadth of rostrum	Alveolar length of upper max. tooth-row	Least interorbital breadth
3 mi. W Durango												
♀	3 av.....	225	65	28	40.1	13.1	25.7	21.0	16.6	8.1	8.3	6.5
	Max.....	230	67	29	40.4	13.5	25.8	21.2	16.8	8.4	8.5	6.6
	Min.....	219	63	28	39.9	13.0	25.7	20.6	16.5	8.4	8.1	6.4
♂	70054 <sup>4</sup> .....	262	87	35	45.0	15.6	27.9	22.7	19.7	9.3	9.8	6.4
	70055 <sup>4</sup> .....	248	79	31	43.3	14.0	27.6	22.1	17.1	8.7	8.2	6.2
12 mi. W Pagosa Springs												
♀	72971 <sup>4</sup> .....	217	65	27	39.1	12.8	.....	20.0	15.4	7.4	8.7	6.2
	72970 <sup>4</sup> .....	238	70	29	42.7	15.0	27.5	21.8	17.2	8.8	8.3	6.5
<i>Thomomys bottae pervagus</i> , Antonito												
♀	133668 <sup>1</sup> sad.....	208	69	29	37.3	12.9	23.1	18.2	15.8	7.5	8.0	6.9

Española, New Mexico												
♀	1336161	249	82	38	41.1	.....	24.6	20.0	16.3	8.2	8.1	7.1
♀	1336191	216	65	32	40.6	.....	24.9	19.3	.....	8.0	8.0	6.8
♂	582931	244	76	31	44.0	.....	26.9	21.2	18.3	8.8	8.1	6.6
<i>Thomomys bollae invernatus</i> , Salida												
♀	11 av.	219	67	31	38.6	.....	13.4	23.2	19.5	15.4	7.6	6.5
	Max.	242	80	34	40.4	.....	14.2	25.0	20.2	16.2	8.1	6.9
	Min.	196	45	29	37.6	.....	12.9	21.9	18.8	14.8	7.3	6.3
♂	3 av.	247	74	32	42.9	.....	16.1	25.1	20.9	18.0	8.2	6.3
	Max.	248	74	33	43.7	.....	16.3	26.4	21.7	18.1	8.8	6.4
	Min.	247	74	32	42.2	.....	15.9	25.8	20.5	17.9	7.9	6.3
12 mi. N Cañon City												
♀	729154	230	81	28	38.1	.....	13.0	22.6	19.4	15.0	7.9	6.7
♀	729474	228	74	27	38.7	.....	14.0	23.6	19.8	15.9	8.2	6.8
1 mi. W Coaldale												
♀	700424	224	70	30	38.1	.....	13.1	23.5	19.5	15.6	7.7	6.6
5 mi. S Cotopaxi												
♀	729324	224	65	27	39.1	.....	13.8	24.3	20.4	15.5	7.7	6.5
♂	729254	250	74	29	44.0	.....	16.2	27.5	22.8	18.7	9.0	6.1





## 11 mi. WNW Gardner

227	64	28	37.9	13.0	22.5	18.8	14.8	7.3	8.0	6.7
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## 1½ mi. S Redwing

227	73	28	39.0	13.1	23.1	18.8	15.6	7.8	8.0	6.8
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## 1 mi. E La Veta

254	88	32	42.4	15.1	27.5	21.8	17.3	8.4	8.2	6.5
239	80	32	42.3	16.5	27.8	22.0	17.9	8.7	8.1	6.4

*Thomomys bottae cullellus*, Fishers Peak

214	64	27	37.2	13.0	.....	19.0	15.3	7.7	7.6	6.5
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*Thomomys bottae rubidus*, holotype and topotypes

233	80	28	40.6	14.2	25.1	20.8	16.7	8.8	7.5	6.9
225	80	28	40.3	14.2	24.6	20.6	16.6	9.2	7.2	6.9
3 av.	89	31	44.7	15.7	27.8	22.6	18.6	10.1	7.4	6.9
Max.	270	32	45.1	15.9	28.1	22.7	18.8	10.4	7.6	7.0
Min.	255	30	44.2	15.5	27.5	22.5	18.5	9.8	7.2	6.8

sad, denotes subadult.

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2. E. R. Warren Collection.

3. Colorado State University.

4. Museum of Natural History, University of Kansas.

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